US4387587: Motor vehicle deceleration data acquisition and processing apparatus and methodology

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Abstract:

The decelerating movement of a vehicle during a skid test is sensed by an accelerometer which provides an analog signal representative of the deceleration to a computer where the analog signal is periodically sampled and converted into a digital deceleration signal for storing in a computer memory. Alternatively, the decelerating movement of the vehicle may be sensed by a radar speed detector providing digital signals representative of the initial speed and final speed of a time increment to a computer processor which records and stores the digital speed signals in computer memory to be later recalled to produce a digital deceleration signal. The computer processor effects storing of the digital deceleration signals in the computer memory at the beginning of a skid test when the magnitude of the signals exceeds a predetermined threshold level as sensed by a threshold level detector or, alternatively, when a mercury position switch is operated by the deceleration force. Subsequently, the stored deceleration data is retrieved from the computer memory by the processor for performing selected mathematical operations on the data to derive information such as the coefficient of friction encountered by the skidding vehicle, the length of the skid, and the time duration of the skid. The results of the mathematical operations may be displayed on a digital display panel or printed on a tape to provide a permanent record.

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What is claimed and desired to secure by Letters Patent is:

1. Apparatus for providing a deceleration history of a vehicle during a skid test, comprising:

(a) sensing means for sensing the decelerating movement of a vehicle during a skid test and producing a signal representative of the decelerating movement of the vehicle;
(b) computer means receiving the signal from said sensing means and periodically sampling and processing the signal to periodically produce a digital deceleration signal indicative of the deceleration of the skidding vehicle;
(c) skid detecting means for detecting the beginning of a skid test and providing an actuating signal;
(d) said computer means having memory means for storing the digital deceleration signals; and
(e) said computer means being operable in response to the actuating signal for effecting storage of the digital deceleration signals in said memory means so as to provide a deceleration history of the skid test.

BACKGROUND OF THE INVENTION

This invention relates to the measurement of road surface friction encountered by a vehicle skidding along a road, and more particularly to a method and an apparatus for obtaining data concerning the deceleration of a vehicle during a skid test and processing the deceleration data to determine such factors as the length of the skid and the coefficient of friction between the road surface and the skidding vehicle.

In a skid test, a vehicle is driven along a road at an initial speed, and then the brakes of the vehicle are applied so as to lock the wheels of the vehicle and cause it to skid to a stop. As is known, a vehicle skidding to a stop will leave skid marks, and the length of such a skid mark is indicative of both the speed of the vehicle when the skidding began and the road surface friction which is expressed as a coefficient of friction. However, during a skid test a vehicle also undergoes deceleration, and the rate of deceleration and the time required for the decelerating vehicle to skid to a stop from an initial speed are also indicative of the coefficient of friction and the length of the skid.

In the past, law enforcement agencies have utilized the skid marks of a motor vehicle involved in an accident to estimate a minimum speed that the accident vehicle was traveling when the skidding began. However, before estimating the speed of the accident vehicle it is first necessary to determine the coefficient of friction for the particular section of road where the accident occurred, and this is accomplished by performing a skid test over the particular road section. The speed of the test vehicle when same begins skidding, is often determined by a

conventional radar speed detector, and upon measuring the length of the resulting skid marks the coefficient of friction may be calculated according to the formula:

Coefficient of Friction=(speed of test vehicle in miles per hour)2 /F×(length of skid test in feet) wherein F as used herein is a constant equal to [(3600 seconds)2 × miles2 ×2×32 feet/second2 ×hours2 ×(5280 feet)2] or [29.75 miles2 /hour2 - feet] or as is usually rounded to a value of 30.

However, in determining the coefficient of friction by a method utilizing the length of the skid marks, it is important to accurately located the point at which the test vehicle began skidding, and this is usually accomplished by having personnel along the side of the road to actually witness the lock-up of the wheels. Afterwards, the personnel must move onto the road to measure the length of the skid marks left by the test vehicle. Such a procedure is disadvantageous because of the amount of time it requires and the number of personnel involved in witnessing the wheel lock up. Moreover, since the skid test must be performed along the section of road where an accident occurred, the test necessarily involves stopping or diverting traffic from that area, and if traffic is allowed to resume on a limited basis while the skid marks are being measured, then those measuring the skid marks are exposed to potential traffic hazards.

In the past, apparatus has been developed for measuring the coefficient of friction without requiring personnel to witness a wheel lock-up or to measure the length of skid marks, but such measuring apparatus usually involves bulky and relatively expensive equipment in the form of an extra wheel or a trailer to be towed along the road behind a vehicle. Due to the bulkiness, such measuring apparatus is unsuitable for being carried as standard equipment in a law enforcement vehicle, and accordingly the measuring apparatus must be brought to the scene of an accident from a storage location which may be many miles away. This necessarily involves a delay in measuring the coefficient of friction, and a further delay may be incurred when the measuring apparatus is not readily available but perhaps is being used elsewhere. During such delays conditions may change on the road surface to substantially modify the coefficient of friction associated therewith. However, the principal factors affecting the value of the coefficient of friction at the scene of an accident may be the presence of ice, snow, water, debris or foreign particles on the surface of the road. When such factors may vary substantially in a relatively short period of time due to changes in the weather or the passage of traffic, it is desirable to minimize any delay in measuring the coefficient of friction. It is further noted that the present invention may be utilized to appraise users of a roadway with information relevant to surface conditions, especially a relative braking efficiency as compared to a clean and dry surface. Such information may be provided to aircraft pilots landing on airport runways, automobile drivers during inclement weather, and the like.

OBJECTS OF THE INVENTION

Accordingly, an object of the present invention is to provide a method for determining the coefficient of friction encountered by a vehicle during a skid test without measuring the length of the skid.

Another object of the invention is to provde a method for determining the coefficient of friction encountered by a vehicle during a skid test by calculations involving measurements of the deceleration of the vehicle during the skid test.

A further object of the present invention is to provide a compact and easily portable apparatus for determining the coefficient of friction encountered by a vehicle during a skid test, preferably such that same may be carried as standard equipment in a law enforcement vehicle so as to minimize any delay in measuring the coefficient of friction at the scene of an accident.

An additional object of the invention is to provide an apparatus for obtaining a deceleration history of a vehicle during a skid test and processing that information to determine the coefficient of friction encountered by the vehicle during the skid test.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawings wherein are set forth, by way of illustration and example, certain embodiments of the invention.

The drawings constitute a part of this specification including exemplary embodiments of the present invention and illustrate various objects and features thereof.